

## 2.5 Assessment of the Brush Concepts

An assessment of the brush concepts is performed with + = good, o = average and - = poor, with the focus on the cleaning level. The sealing of the housing, as well as the rotational direction of the blades are associated with manufacturing expense. The construction expense is of a subordinate role, as long as realization is possible.

[see original]

Brush concept	1	2	3	4	5	6	7	8	9	10
Criterion										
Cleaning level/										
Shaver base										
Blade block										
Shear blade										
Blade block underside				[see original]						
Manufacturing expense										
Rotational direction										
Sealing of housing										
Service life										
Construction expense										

! No rotation, but expensive, oscillating translation

Selected

Concept 10 is pursued, due to its good cleaning effect, low construction and manufacturing expense, lack of sealing problems, average service life (capable of improvement), as well as rotational direction problems.

Concepts 2, 3, 4, 5, 6 + 8 must be excluded, because only poor cleaning is possible in various areas.

Concepts 1, 7 + 9 may be pursued, with restrictions. Refer to Disadvantages under 2.6.1, 2.6.7 + 2.6.9.

B005250

## Kinds of Bristles

Page 32

[see original]

Brushes \ Shaver Undercut Shaver base	Bristle length 10	Bristle length 30	Bristle length 50
	Hard hard soft Hard bristles bristles	Hard hard soft Hard bristles bristles	Hard hard soft Hard bristles bristles

+ = good, o= average and -= poor

B005251

## 2.8 Bristle Selection

Available bristles:

	Diameter (mm)	Active material
Individual fibers	[see original]	Nylon
Tiny brushes		Nylon
Washing brushes		Nylon
		Nylon
		Pig bristles
Oral B toothbrushes		Nylon
Bottle brushes, Company: Topp Frankfurt		Pig bristles
Small cleaning brushes from the shaver		Nylon

All available bristle and brush types were used for the preliminary trials. Even in the brush concepts, some types can be excluded (Page 31).

Following the assessment of the kinds of bristles for their cleaning effect under 2.7 on Page 32 and the requirement of a 90% cleaning level, only radial brushes with soft bristles of 30-50 mm in length still come into question. To select an appropriate brush in this first step, a visual estimate of the cleaning level is sufficient. The further trials refer to double-row, linear brushes that can be manufactured without great expense with nylon bristles available in the plant. A stroboscope lamp is used to observe the entanglement and buckling process of the bristles between and among the blades, as well as in the undercuts.

B005252

## Test and Assessment of the Selected Brush

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## 3.0 Test and Assessment of the Selected Brush

i	Age of beard		1	1	1		
1	Before shaving	Complete shaver,					
2		Shaver w/out shear					
3		blade, Shear blade					
4	After shaving	Complete shaver,					
5		Shaver w/out shear					
6		blade, Shear blade					
7	Bristle diameter (mm)						
8	Bristle diameter (mm)						
9	Revolutions (min <sup>-1</sup> )						
10	Cleaning level without housing: brush only			[see original]			
11							
12							
13							
14							
15							
16	Shaver dust						
17							
18							
19							
20							
21							

1) Complete shaver 2) Shaver without shear blade 3) Shear blade

Table 3.0

Note: the required cleaning level of 90%, or rather, the removal of the dust within the system boundary of the shaver is achieved. Double-row, linear brushes with 96 mm long bristles are appropriate for a cleaning station.

The cleaning level achieved is above 95% (rows 12,15,18).

The individual function "Removing Shaver Dust" is thus fulfilled.

B005253

## Test and Assessment of the Selected Brush

Page 35

## 3.1 Test and Assessment of LV1t [see original]

i	Age of beard		1	1	1	
1	Before shaving	Complete shaver,				
2		Shaver w/out shear blade,				
3		Shear blade				
4	After shaving	Complete shaver,				
5		Shaver w/out shear blade,				
6		Shear blade				
7	Bristle diameter (mm)					
8	Bristle diameter (mm)					
9	Revolutions (min <sup>-1</sup> )					
10	Cleaning level without housing: brush only		[see original]			
11						
12						
13						
14						
15						
16						
17						
18						
19, 20, 21	Can	Before shaving m (g)				
22, 23, 24, 25, 26,		After shaving M (g)				
27, 28, 29	Shaver dust					

1) Complete shaver 2) Shaver without shear blade 3) Shear blade

Table 3.1

With regard to LV1t under 2.3.4 "Collecting Shaver Dust," it is examined here as to whether a simple collection box collects, as per requirements (only 10% of the removed dust may escape externally).

A collection box without suction does not guarantee the requirement that 90% of the dust removed from the shaver be collected within the system boundary. See Row 26 (percent shaver dust volume within the system boundary).

LV2t must be tested and assessed.

B005254

[see original]

1. released on

[illegible]

free measurement tolerances

date name

[illegible]

### **BRAUN**

active agent [illegible]

ELEMENTARY MODEL FOR LV2t

CLEANING STATION

measurement

reduced in size

2. We reserve all rights for this [illegible].
3. Top view
4. Opening for shaver
5. Front view
6. Motor space
7. Motor
8. Handheld vacuum
9. Shaver
10. Opening for suction
11. Dust  
Dust filter  
Handheld vacuum nozzle
12. Introduce shaver
13. Shaver
14. Brush: [illegible]
15. Pass volume [illegible]

B005255

### 3.3 Test and Assessment of Elementary Model of LV2t, with varying bristle thickness and rotational speed

#### 3.3 Contrast hand cleaning / cleaning station

[see original]

1. Cleaning level (%)
2. Complete shaver  
Shaver without shear blade  
Shear blade
3. Hand cleaning  
Cleaning station

Fig. 3.3 shows that the cleaning station achieves the same overall cleaning level as the manual cleaning under 1.3 on Page 8. The shaver body with blade block is somewhat worse, while the shear blade is cleaned significantly more thoroughly. It emerges from Tables A-11 through A-14 that as bristle diameter increases, the rotational speed of the brushes can be increased without the bristles buckling sideways or wrapping around the rotational axis. This is, in principle, advantageous, since the cleaning time is shortened for the same cleaning level. The average amount of shaver dust within the system boundary of the cleaning station is around 81%. A part of the waste is determined by the static charging of hairs and the plastic housing.

The rotational direction of the motor is changed by polar reversal on the net device.

Suction occurs by means of a hand vacuum customary to the trade, modified on the suction tube, because it offered the fastest solution. Suction performance can be detected with a rotating brush on the feed opening. Loose dust from the shaver / shear blade can be suctioned off at the opening.

## Criticism and Prospects

### 4.1 Brushes

The bristles bend into an S-shape during rotation, due to the wind resistance. Therefore, the tips of the brushes run on a smaller, divided circle diameter. The overall diameter of the brush can therefore be designed approx 1-2 mm larger than the interior diameter of the housing. If the bristles are longer, then any excess length will split off by striking the housing openings. This can possibly have a positive effect on the cleaning procedure. It can be investigated in a long-term test as to whether the splitting off of the bristles only occurs on excess length and is not critical.

Since the type of brush—a double-row, linear brush with 96 mm bristle length and 0.20 mm bristle diameter—has been well preserved, the company, Mink Bürsten in Göppingen was commissioned with manufacturing a sample brush according to the sketch on Page 43. Results with the brush cannot be documented here any further, due to time constraints.

### 4.2 Housing:

The housing diameter can likely be reduced from 94 mm to 80 - 85 mm (construction size). For the first elementary models, only Plexiglass tubes of 67 mm and 94 mm in diameter were available. The 67-mm tube proved to be too small, since even at rotational speeds of  $800 \text{ min}^{-1}$  (depending on bristle thickness), the bristles wrapped around their own axis.

In the 94 mm housing, the brush can be loaded up to  $4,000 \text{ min}^{-1}$ .

### 4.3 Shaver

The swiveling shaver head may not clamp down on one of the dead points, so that the removal of the shaver is guaranteed.



#### 4.4 Drive:

A significant improvement of LV2t on Page 36 is the drive of the fan impeller and brush with only one motor, as in Concept 1. Construction size is considerably reduced. With the aid of a gear, it is possible for the brush and fan impeller to use the rotational speed optimally. Running noises are to be expected.

The housing is divided horizontally at the height of the rotational axis of the brush.

It is possible to design the top part of the housing to be compatible with various types of shavers. The area of the feed opening should be funnel-shaped, so that the loose dust falling out when the shear blade is removed can be collected within the system boundary.

#### 4.5 Fan Impeller:

There are two conceivable types of fan impeller:

- 1) Blades bending backwards: Maximum suction performance in one direction; in the other direction, less than with 2).
- 2) Straight blades; In both directions, lower suction performance than with 1) as a maximum.

If one uses Fan Impeller 1, it first spins in the direction of the least suction performance, then is reversed for full suction.

With Fan Impeller 2, one has constant suction performance over the entire cycle.

#### 4.6 Alternative:

In Concept 2, the brushes, ventilator wheel and motor are arranged on a single axis. One gear is missing. The problems lie in the coordination of rotational speed, since differing circumferential speeds are ideal for brushes and fan impellers. A cassette may be inserted to collect the dust.

#### 4.7 Insertion of the shear blade

In the trials to determine the cleaning level of the cleaning station, the shear blade was kept in the supply opening of the shaver. The soft, fast-rotating brush did not represent any hazard to fingers or the shear blade. The cleaning level lies on average at 96%. In the interior corner in the shear blade, in the dead points of the oscillating blade movement, the hardest to remove dirt is found. The insertion of the shear blade must occur in a certain corner against the brush, so that the brush tips can reach into the corners. The housing of a functional model should make possible a concurrent insertion and cleaning of the shaver body and shear blade. The shear blade must, since it has become dirty at both ends, either be inserted sideways or turned within the housing. Turning within the housing is technically costly and can reduce the useful life of the brush.

The smallest expense represents an opening in the housing, in which the shear blade is manually attached during the brush run. Since the brush in the elementary model changes rotational direction, both corners in the shear blade are cleaned. It remains to be determined in trials as to how much dust can possibly escape outside the system boundary through the shear blade opening.

In experiments, traces of very fine, white dust, were detected, which is the minimum abrasion of the bristles on the shear blade. This could only be seen on the black shear blade frame.

[see original]

1. [illegible]
2. Introduce shaver
3. lid compatible for other shavers
4. shaver dust
5. dust filter
6. dust box with filter, for exchange, for rinsing
7. change
8. park position, shaver for charging
9. Johnson motor [illegible]
10. Motor control
11. attach for brushing
12. Brush [illegible]
13. opening for suctioning
14. dust [illegible] / dust
15. Fan impeller: 10,000 min<sup>-1</sup>
  - straight blades, lower suction performance
  - backward-bending blades
    - first rotational direction worse
    - second rotational direction better
16. released on

[illegible]

free measurement tolerances  
date name  
[illegible]

active agent [illegible]  
CONCEPT I

B005260

[see original]

1. Introduce shaver
2. table device
3. housing top part compatible for other [illegible] shavers
4. folds open to change brush
5. dust cassette for changing!
6. park position, shaver for charging
7. Johnson motor  $4,000 - 10,000 \text{ min}^{-1}$  depending on brush
8. motor control
9. fan impeller, problematic as in Concept 1
10. suction channel
11. [illegible]
12. dust collection
13. introduce shaver
14. brush holder
15. rough filter (when changing cassette, no dust must get into the brush chamber)
16. released on

[illegible]

free measurement tolerances

date name

[illegible]

active agent [illegible]

CONCEPT 2

B005261

Sketch of brush

Page 43

[see original]

1. To Mr. Steinbrunner
2. HOUSING
3. for motor axis
4. [illegible]

Type: <u>double-row, linear [illegible]</u> Body material: } <u>PVC</u> Shaft (tube) material: } Total $\varnothing$ (tolerance): <u>72 + 96</u> E Core $\varnothing$ : <u>8 - 9</u> C Total length (tolerance): <u>61</u> B Roll length: <u>56</u> A Working width over brush: <u>54</u> Working width: <u>as discussed</u> D Pivot $\varnothing$ : $d_1$ $d_9$ <u>4</u> (tolerance) $I_1$ $I_9$ <u>5</u> feather n. DIN 6885 Bl. 1: <u>B</u> [illegible] Shaft (tube) $\varnothing$ <u><math>d_2</math></u> Distance from outside a: <u>as discussed</u>		Bristle material: <u>nylon</u> Bristle color: <u>black</u> Bristle $\varnothing$ : <u>+ 0.20</u> LA: <u>as discussed</u> Reaming on the circumference: <u>as discussed</u> Bundle hole $\varnothing$ : [illegible], <u>if possible</u> . Punching thread: naked wire. galvanized V2A, V4A Temperature set at: $^{\circ}\text{C}$ Chemical resistance to: Rotational speed $\text{min}^{-1}$ : <u>as high as possible</u> Balancing: yes/no stat./ dyn. Intended use: <u>as discussed</u>
With the request for an offer KW22; delivery, if necessary KW 23.		
Art. No. <u>Mr. Zeischke</u> <u>T-EF1</u> <u>Braun AG</u> <u>6242 Kronberg</u> <u>Fax: 06173 / 302440</u> <u>[illegible]</u>	Date [illegible] Processed <u>23.5 [illegible]</u> Tested Standard	Measurement K. No. Customer <u>Braun AG / T-EF1</u> Mink Bürsten <u>Brushes for cleaning station</u> [illegible]

B005262

**Clean the device after each shave**

All stubble that the device has shaved off is found in the shaver head after shaving. It is worthwhile to remove it each time directly following shaving and not to wait until the device is really dirty or even its performance is reduced. How do you clean a shear foil shaver?

- Place the protective cover on the shaver head, so that nothing can happen to the foil,
- Pull back the shaving head,
- Tap or blow the stubble out,
- Using the small brush that comes with your device, clean the blade block. Never use the small brush to clean the shear foil - it could be damaged!
- Let the device run without the shaving head for 2-3 seconds – This shakes any remaining stubble out.
- Using special cleaning sprays available in a specialized store, you can clean your device once a week more thoroughly. These sprays also dissolve any sebum residue from the cutting edges of the blade block and/or blade.
- If you do not use any spray, it is recommended that a more thorough cleaning be performed with a fat-dissolving liquid every one or two months.

[see  
original]

Source: Braun Nathan International, Page 27

B005263

Manual Shaver Cleaning

Page A – 2

**BRAUN****SHAVER SYSTEM****FREQUENCY OF SHAVER HEAD CLEANING (IN %)**

METHOD	AFTER EACH SHAVE	2 – 3 TIMES PER WEEK	WEEKLY	MONTHLY	SELDOM
BLOWING	43	12	10	2	1
TAPPING	37	9	9	2	-
BRUSHING	26	10	32	10	5
SHAKING	10	7	6	5	3

SOME ITEMS ARE MENTIONED MORE THAN ONCE

Fig. A – 2

Source: Market research 1982 by BRAUN  
Users of Braun devices in Germany

B005264

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**BRAUN**


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**SHAVER SYSTEM**


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**METHODS OF SHAVER HEAD CLEANING**

• BRUSHING OFF	29%		
• BLOWING OFF	24		
• TAPPING OFF	21	}	HERE, ONLY LOOSE
• SHAKING OFF	11		HAIR DUST IS
			REMOVED
• CLEANING LIQUID	9		
• OTHER LIQUID	5	}	BRUSHING OFF
• CLEANING SPRAY	1		IS ALSO
			NECESSARY
	<hr/>		
	100%		

Fig. A – 3

Source: Market research 1982 by BRAUN  
Users of Braun devices in Germany

B005265



**BRAUN**

**SHAVER SYSTEM**

**GENERAL SATISFACTION WITH SHAVER HEAD CLEANING**

- VERY SATISFIED ~ 40%
  - LARGELY SATISFIED ~ 41
  - MORE OR LESS SATISFIED ~ 13
  - NOT VERY SATISFIED ~ 4
  - NOT AT ALL SATISFIED ~ 2
- ~ 100%

Fig. A – 4

Source: Market research 1982 by BRAUN  
Users of Braun devices in Germany

B005266

A – 5.1 Characteristics of Shaver Dust

General size:

Hair density:  $1.34 \text{ g / cm}^3 \pm 0.02 \text{ g / cm}^3$

Hair growth:  $0.38 \text{ mm / day} \pm 20\%$

Hair thickness:  $140 \text{ } \mu\text{m} \pm 30 \text{ } \mu\text{m}$

Number / surface:  $50 \text{ / cm}^2$   $\Sigma 30... 90 \text{ / cm}^2$

Shaver-related sizes:

Shaver surface:  $310 \text{ cm}^2 \pm 57 \text{ cm}^2$

Particle size:  $20 \text{ } \mu\text{m}$

Mass / day:  $\emptyset 45 \text{ mg.}; \text{ max. } 74 \text{ mg.}$

Refer to Fig. A – 5 and Fig. A – 6

[see original]

Fig. A – 5.2 Shaver dust of hairs, skin and sebum  
Image taken with a camera microscope with 37.2X magnification

B005267

Shaver Dust Analysis

Page A – 6

[see original]

Beard hair cut by oscillation, under the scanning electron microscope (without skin and sebum)

Source: REM, Braun

B005268

Observed Measurements of Shaver CleaningPage A – 7

[see original for figures]

i	Beard age	
1	before shaving	complete shaver
2		shaver without shear blade
3		shear blade
4	after shaving	complete shaver
5		shaver without shear blade
6		shear blade
7	loose dust	complete shaver
8		shaver without shear blade
9		shear blade
10-18	Cleaning: Switch on shaver, tap out shear blade	
19-27	Cleaning with small brush	
28-36	Thorough cleaning with small brush	
37-42	Shaver dust	total
43-46	Waste	outside shaver
		inside shaver
1) Complete shaver, 2) Shaver without shear blade, 3) shear blade		

Table A - 7

B005269

Observed Measurements of Shaver Cleaning

Page A – 8

[see original for figures]

i	Beard age	
1	before shaving	complete shaver
2		shaver without shear blade
3		shear blade
4	after shaving	complete shaver
5		shaver without shear blade
6		shear blade
7	loose dust	complete shaver
8		shaver without shear blade
9		shear blade
10-18	Cleaning: Switch on shaver, tap out shear blade	
19-27	Cleaning with small brush	
28-36	Thorough cleaning with small brush	
37-42	Shaver dust	total
43-46	Waste	outside shaver
		inside shaver

1) Complete shaver, 2) Shaver without shear blade, 3) shear blade

Table A - 8

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Observed Measurements of Shaver CleaningPage A – 9

[see original for figures]

i	Beard age	
1	before shaving	complete shaver
2		shaver without shear blade
3		shear blade
4	after shaving	complete shaver
5		shaver without shear blade
6		shear blade
7	loose dust	complete shaver
8		shaver without shear blade
9		shear blade
10-18	Cleaning: Switch on shaver, tap out shear blade	
19-27	Cleaning with small brush	
28-36	Thorough cleaning with small brush	
37-42	Shaver dust	total
43-46	Waste	outside shaver
		inside shaver

1) Complete shaver, 2) Shaver without shear blade, 3) shear blade

Table A - 9

B005271

Observed Measurements of Shaver CleaningPage A – 10

[see original for figures]

i	Beard age	
1	before shaving	complete shaver
2		shaver without shear blade
3		shear blade
4	after shaving	complete shaver
5		shaver without shear blade
6		shear blade
7	loose dust	complete shaver
8		shaver without shear blade
9		shear blade
10-18	Cleaning: Switch on shaver, tap out shear blade	
19-27	Cleaning with small brush	
28-36	Thorough cleaning with small brush	
37-42	Shaver dust	total
43-46	Waste	outside shaver
		inside shaver

1) Complete shaver, 2) Shaver without shear blade, 3) shear blade

Table A - 10

B005272

Observed Measurements of Shaver Cleaning Page A – 11

[see original for figures]

i	Number of shaves	
ii	Beard age	
1	Before shaving	complete shaver
2		shaver without shear blade
3		shear blade
4	After shaving	complete shaver
5		shaver without shear blade
6		shear blade
7	Bristle diameter (mm)	
8	Brush diameter (mm)	
9	Revolutions (min <sup>-1</sup> )	
10-18	Cleaning station with suction	
19-21	Handheld vacuum	before shaving
22-26	nozzle	after shaving
27-29	Shaver dust	

1) Complete shaver, 2) Shaver without shear blade, 3) shear blade

Table A – 11

Note:

Cleaning station sealed between housing and suction tube.

B005273



Observed Measurements of Shaver CleaningPage A – 12

[see original for figures]

i	Number of shaves	
i	Beard age	
1	Before shaving	complete shaver
2		shaver without shear blade
3		shear blade
4	After shaving	complete shaver
5		shaver without shear blade
6		shear blade
7	Bristle diameter (mm)	
8	Brush diameter (mm)	
9	Revolutions (min <sup>-1</sup> )	
10-18	Cleaning station with suction	
19-21	Handheld vacuum	before shaving
22-26	nozzle	after shaving
27-29	Shaver dust	

1) Complete shaver, 2) Shaver without shear blade, 3) shear blade

Table A – 12

Note:

Cleaning station sealed between housing and suction tube.

B005274

Observed Measurements of Shaver CleaningPage A – 13

[see original for figures]

i	Number of shaves	
i	Beard age	
1	Before shaving	complete shaver
2		shaver without shear blade
3		shear blade
4	After shaving	complete shaver
5		shaver without shear blade
6		shear blade
7	Bristle diameter (mm)	
8	Brush diameter (mm)	
9	Revolutions ( $\text{min}^{-1}$ )	
10-18	Cleaning station with suction	
19-21	Handheld vacuum	before shaving
22-26	nozzle	after shaving
27-29	Shaver dust	

1) Complete shaver, 2) Shaver without shear blade, 3) shear blade

Table A – 13

Note:

Cleaning station sealed between housing and suction tube.

B005275

Observed Measurements of Shaver CleaningPage A – 14

[see original for figures]

i	Number of shaves	
i	Beard age	
1	Before shaving	complete shaver
2		shaver without shear blade
3		shear blade
4	After shaving	complete shaver
5		shaver without shear blade
6		shear blade
7	Bristle diameter (mm)	
8	Brush diameter (mm)	
9	Revolutions ( $\text{min}^{-1}$ )	
10-18	Cleaning station with suction	
19-21	Handheld vacuum	before shaving
22-26	nozzle	after shaving
27-29	Shaver dust	

1) Complete shaver, 2) Shaver without shear blade, 3) shear blade

Table A – 14

Note:

Cleaning station sealed between housing and suction tube.

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List of References

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A – 15 List of References

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Patent Dept. Braun AG  
REM Dept. Braun AG  
Documentation Braun AG

Dr. Jung, Engineer; Braun AG  
Mr. Klauer; Braun AG  
Mr. Jung; Braun AG  
Mr. Steinbrunner; at the company Mink Bürsten

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